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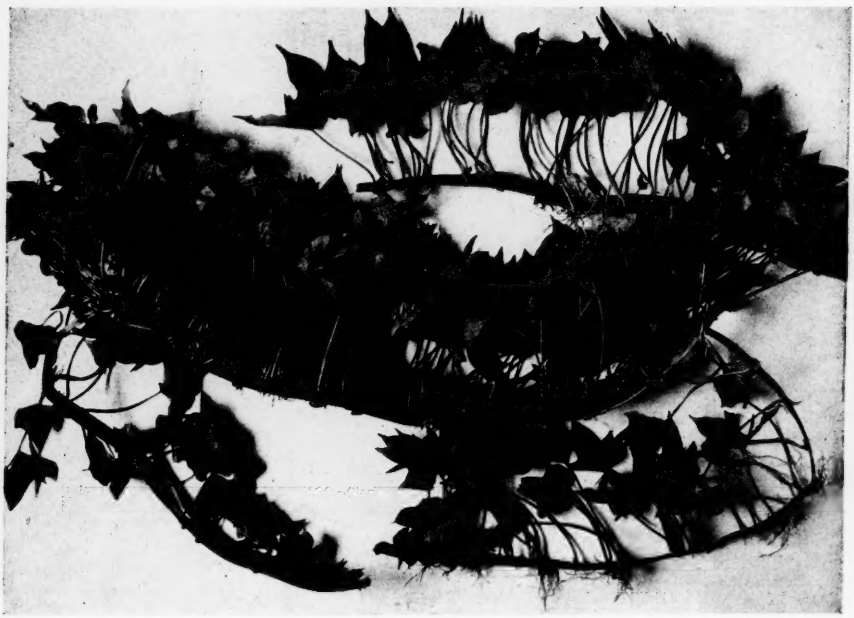

FASCIATED SWEET-POTATO
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Rh-Feeblemindedness Confirmed

Hereditary Deformities in Man

"Vestiges of Creation"

A Headless Lamb

Hooded Phlox

VOLUME 36 JANUARY, 1945 NUMBER 1

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The

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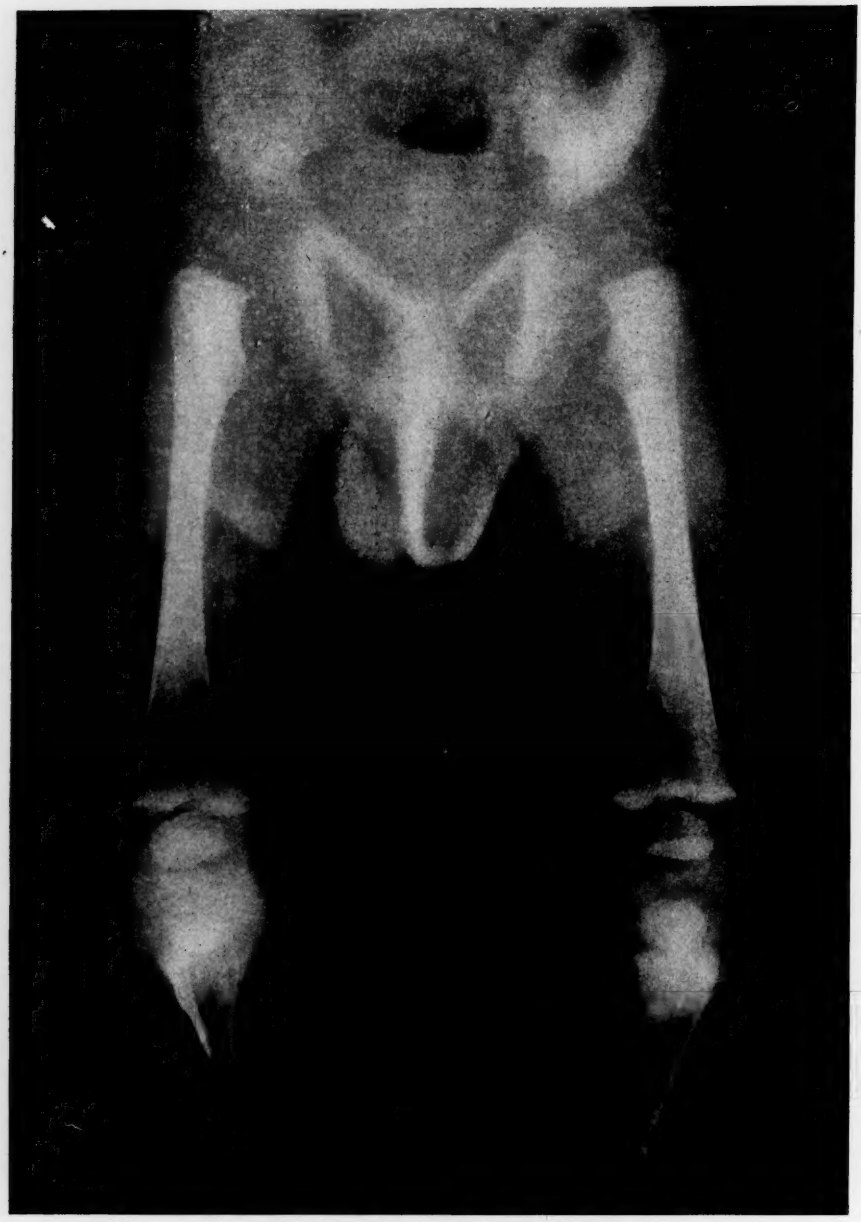

ANOMALIES OF LOWER EXTREMITIES

Figure 1

This hereditary defect in its extreme form is characterized by amputation of both feet, all bones below the fibia being absent. Note also the shortness of tibias and fibulas. The soft tissues extend well beyond the ends of the bones. In this respect this case differs from congenital amputations.

HEREDITARY DEFORMITIES IN MAN

Due to Arrested Development

FORREST H. ADAMS AND C. P. OLIVER
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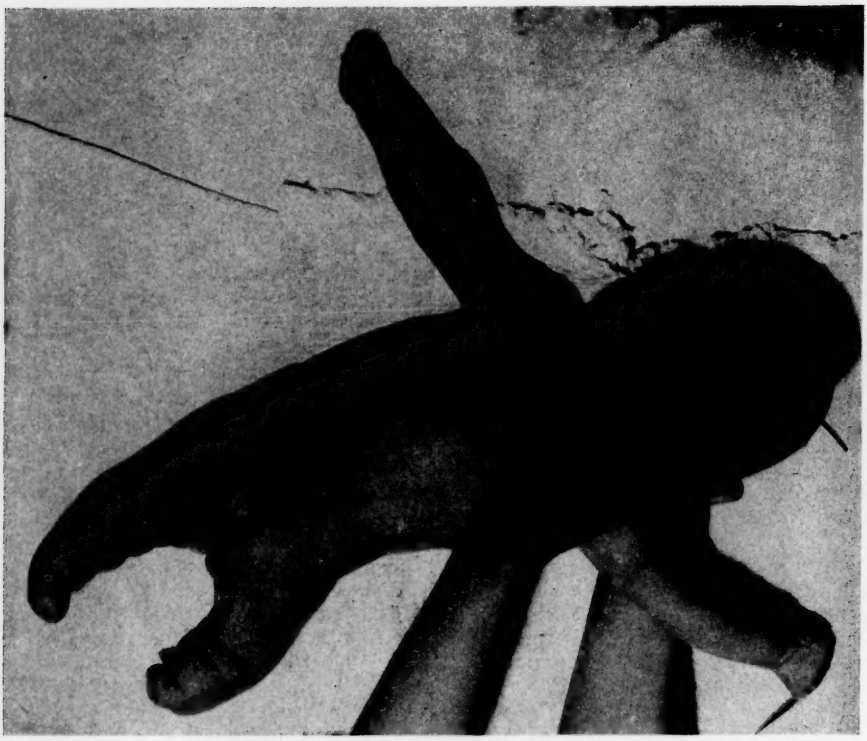
THERE are numerous reports in the literature[1,2,3] of a condition described as "congenital amputations." These malformations are usually multiple, frequently involving both the upper and lower extremities. It has been well shown by Streeter,[4] in his work on human fetuses, and by Bagg[5] in his experimental work in mice, that these amputations are a result of lesions or deficiencies of the soft tissue in the area concerned. Prior to the publication of these reports, such amputations were believed due to constrictions by amniotic bands or by the umbilical cord. In discussing congenital amputations, Streeter also mentioned a condition which he believed to be distinct from the amputations. In these cases there was an arrest of development, or an agenesis of the bony framework with accompanying changes in the soft tissues. He cited two cases of the latter disorder, but in neither case was there family history of the defects. Congenital defects of the extremities have also been produced experimentally in rats by feeding the pregnant animal diets deficient in certain essentials.[6]

We have had a patient at the University of Minnesota Hospital whose condition is similar to the cases of arrested development which Streeter described. In addition, our patient had a defect in the scalp and skull that has not been previously described. Furthermore, defects similar to those which appeared in the patient also occurred in six other members of his family. The family history of the patient suggests that the defects are inherited as a dominant trait with variable expression (as shown in the pedigree chart, Figure 5). This case and the family history are reported because it is the first recorded instance of a trait inherited as a dominant that gives rise to a condition similar to congenital amputations. For reasons which will be stated, we do not consider the trait to be acheiropodia.

Family History

The patient, A.M., was born one month prematurely at the University of Minnesota Hospital on December 19, 1943, and weighed 2,200 grams. Multiple anomalies of the left hand and both feet, as well as a denuded bleeding area on the vertex of the scalp were noticed at birth. The latter was at first thought to be the result of injury from the delivery. The patient was treated as a premature infant for one month. At the time of his discharge from the hospital, the excoriated area on the scalp appeared to have undergone partial healing. Three and one-half months later, however, the baby was readmitted to the hospital because, according to his mother, the wound of the scalp had become infected and had failed to respond to local treatment given by her. It was on this admission to the hospital that a complete family history was obtained.

Physical examination of the infant at this time revealed an ulcerated, infected lesion eight centimeters in diameter over the vertex of the scalp (see Figure 2). There was a very noticeable bony defect in the skull about five centimeters in diameter immediately below the lesion. This is shown in the roentgenogram reproduced in Figure 4. The lower layers of the skin were intact and separated the lesion from the meninges. The right arm and hand were normal. The left arm was normal to the wrist, but, as shown by the x-rays in Figure 3, the carpal bones were only questionably present, and three metacarpals and all



ABNORMAL EXTREMITIES AND SKULL DEFECT

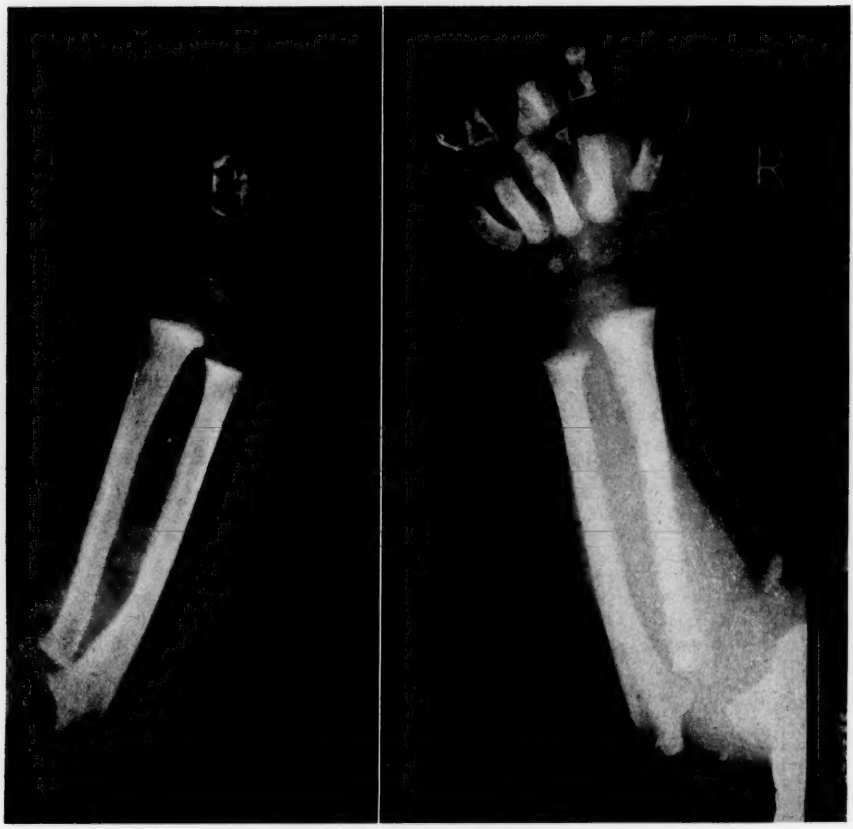
Figure 2

The picture of the patient, A. M., at three months of age shows the deformities of the left hand and both lower extremities. The arrow indicates the ulcerated lesion overlying the skull defect. The normal right hand is covered by a cloth. This child's father had less severe defects of extremities and skull.

the phalanges were absent. The right and left legs were normal to the knees, but the tibias and fibulas were short and no metatarsals, tarsals, or phalanges were present (see Figure 1).

The history of the defect in the family is shown in the pedigree chart. Our patient, A.M., was the seventh child of two unrelated parents. His father was born without any toes except for the great toe on the left foot, with a short terminal phalanx on each of his fingers, and with a scalp defect similar to his son's. Our patient, A.M., has four older brothers who are normal. A fifth older brother, C.M., was born in 1939 with no phalanges, but with three rudimentary toes on his left foot. His right hand was normal, but the index finger and second finger of the left hand were minus the distal phalanx. A defeat was present in his scalp and the underlying skull. In 1936 the mother had a spontaneous abortion at 5½ months of pregnancy at the University Hospital. This fetus, a female 28 centimeters in length, had a rudimentary right foot, an absent left leg beyond the lower half, as well as an absent left hand.

Not much is known regarding the grandparents of A.M., although some of A.M.'s aunts and uncles believe that the



ANOMALIES OF HANDS

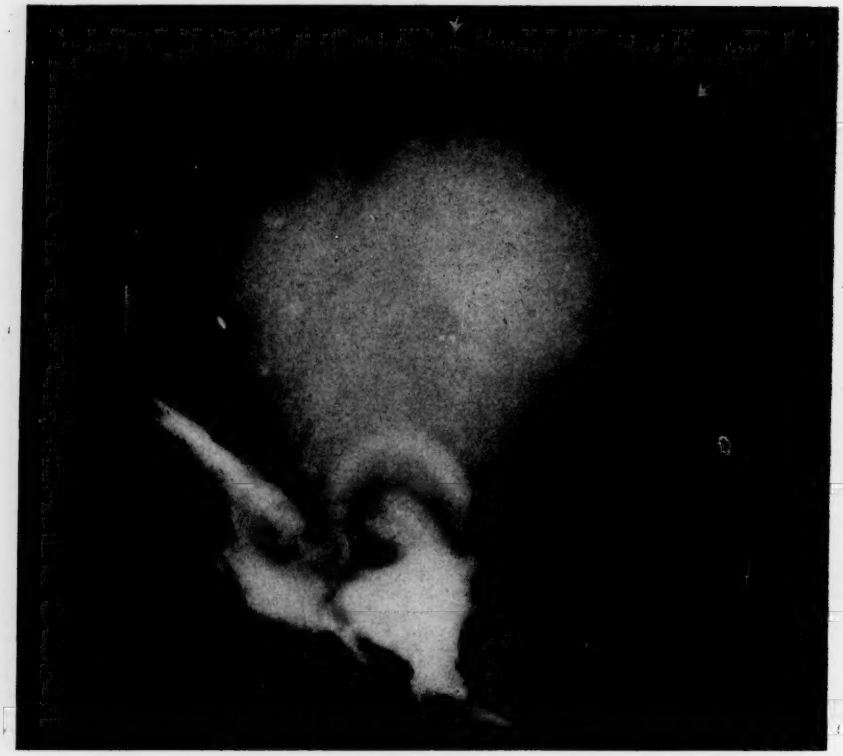
Figure 3

The right hand is normal. It is questionable whether the left has any carpals. It has only two metacarpals, and no phalanges.

paternal grandfather had short fingers. Of the ten children of the paternal grandparents (generation II in the pedigree chart), four, including the father of A.M., exhibited defects. One paternal uncle of the patient was born without feet and without the distal phalanx of each of his fingers. Another uncle exhibited deformities similar to those of A.M. as he was born lacking the left hand and both feet. He is married, but has no children. One female baby born to the grandparents lived only a few hours after birth. She is reported to have had several deformities of the extremities which were not described in detail. Four of the normal children of these grandparents married and have had normal children. The father of A.M. is the only member with the defect who has produced progeny.

Discussion

It seems evident from the cases in the family presented here that this condition is entirely distinct from congenital amputations. The fact that the patient has a stub hand lacking three metacarpal bones



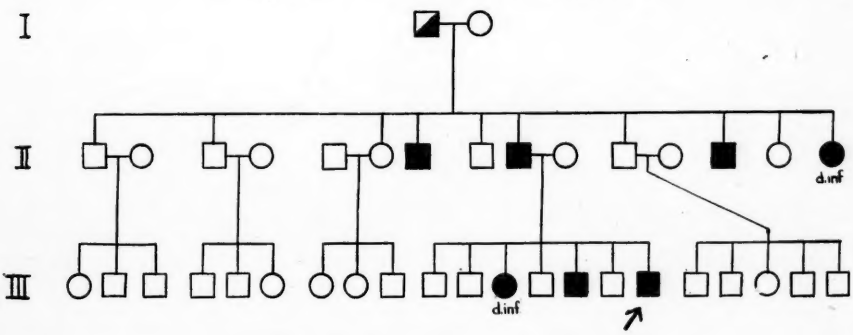
SKULL DEFECT
Figure 4

The area of deficient growth in the skull of A. M. is indicated by arrows. The same anomaly was present in the father and in one living sibling of A. M., and possibly in other relatives.

(two are present) and an associated defect in the scalp and skull supports the suggestion of Streeter that some instances of "amputation" are due to an arrest in development, or an agenesis of certain parts of the skeleton and soft tissues. In congenital amputation, however, there usually is an abrupt termination of the skeletal elements and an associated ring of scar tissue around the amputated area suggesting a lesion of the soft parts. Close inspection of the roentgenograms in Figures 3 and 4 will show that in this case the soft parts extend beyond the ends of the bones.

The characteristics observed in A.M. also differ from congenital amputation in that several members of the family have the defect. The trait has occurred in two of his siblings, in his father, and in three of his father's siblings. There is the suggestion, therefore, that the defect in this family is a hereditary condition which is related to agenesis or to arrest in development of certain parts of the skeleton.

Apparently the trait is inherited in this family as a dominant. The male in generation I, who probably had short fingers, produced children of whom four expressed the defect in one form or other. Only one of the defective persons in the second generation produced children. Three of his seven children



PEDIGREE OF DEVELOPMENTAL DEFECTS

Figure 5

The description of the defects is given in the text. Although the trait is manifested differently in the seven known affected members, each has at least one incompletely developed extremity. The male in generation I probably had shortened digits.

have the defect. None of the normal children in generation II has produced children with the anomaly. Although the pedigree shows that most of the affected persons are males, it cannot be stated that the trait will usually occur in only one sex. The two sibships which include individuals with the anomaly have a preponderance of male children.

The dominant gene for the defect in this family has full penetrance in so far as it can be determined from the history. There is, however, considerable variation in the expression of the gene. In some of the members and in one or more of the hands and feet of a member, the digits may be merely shortened. In others, the digits or the bones of the hands or feet may be absent. In the sibship which includes A.M., the action of the gene is also associated with an arrested development of the skull. This condition is found in the father of A.M. The information about this point in the uncles and aunts is not complete.

Another familial condition similar to the defect in the kinship reported here has been described in the literature as acheiropodia. This by definition means absence of both hands and feet. All of the affected individuals described in this report had at least one or two normal extremities. It seems probable, therefore, that the defect in this family should not be considered as merely another instance of acheiropodia, but one of hereditary arrest in development affecting at least the extremities and the skull. There is no reliable evidence to suggest the possibility that the observed anatomical defects might be caused by deficiencies in the maternal diet.

Summary

1. A family is reported in which eight members had congenital deformities of the extremities, scalp and skull.

2. These deformities varied in their appearance and their degree, illustrating genetic "variable expression."

3. The interpretation is made that the deformities are associated with or caused by a dominant factor.

4. Reasons are given for classifying this condition as distinct from congenital amputations.

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VESTIGES OF CREATION

A Centenary

A HUNDRED years ago—in the Fall of 1844—an anonymous book, entitled *Vestiges of the Natural History of Creation,* appeared in England. At the time it caused much excitement and fierce opposition; and, consequently, it went through many editions. Charles Darwin wrote to his friend, the botanist, Sir Joseph Hooker: "I have read the *Vestiges,* but have been somewhat less amused at it than you appear to have been, the writing and arrangements are certainly admirable but his geology strikes me as bad, and zoology far worse." But later, in the historical introduction to the *Origin of Species,* Darwin said, "It did excellent service in this country in calling attention to the subject, in removing prejudice, and in thus preparing the ground for the reception of analogous views." And Alfred Russel Wallace, at the Darwin-Wallace celebration of the Linnean Society in 1908 mentioned the author of *Vestiges,* together with Buffon, Erasmus Darwin and Richard Owen among the philosophical biologists who had paved the way for the new conception of the origin of species.

Not until many years after the appearance of the *Vestiges* was it admitted by its publisher that the author was a Scotch publicist, Robert Chambers, an extraordinary genius, a self-made man with a minimum of formal education, and a prolific writer on the most diverse subjects. Presumably Chambers preferred anonymity because at the time his controversial book was published, he was running for office as Lord Provost of Edinburgh. The precaution, however, did not assure his success with the electorate.

Chambers claimed that since physical phenomena and inorganic elements are ruled by natural laws, there must also be a fundamental law that governs living things. While God had created the universe and the first living creatures, the further history of the latter had proceeded according to that law. "The great fact established by geologic and paleontologic observations is, that the organic creature as we now see it, was not placed on the scene at once,—it observed a *progress* . . . for geology fully proves that organic creations passed through a series of stages before the highest vegetable and animal forms appeared." He explained the occurrence of new and different forms of life by a process of transmutation of one species into another. He believed, however, that the world of today had attained a state of "completeness" and that "there were no conspicuous examples of a new origin of life or a modification of species at the present day."

At the end of a detailed discussion of man, Chambers summarized "the evidence for the various races of man being descended from one stock. It cannot be considered as conducive, and there are many eminent persons who deem the opposite idea the more probable, but I must say that, without the least regard to any other kind of evidence, that which physiology and philology present seems to me decidedly favorable to the idea of a single origin."

The *Vestiges* is now forgotten. Yet this little book represents the only attempt at a comprehensive treatise in favor of the evolution theory between Lamarck's *Zoological Philosophy* in 1809 and Darwin's *Origin of Species* in 1859. It deserves at least a passing mention on the centenary of its publication.

LILLIAN KAPLAN

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THE RH FACTOR AND FEEBLE-MINDEDNESS

Studies in Human Inheritance XXVI

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THE frequency of clinically diagnosed cases of erythroblastosis has never approached the theoretical frequency to be expected on the basis of random matings. In searching for further effects of the incompatibility of the *Rh* factor in mother and fetus, Schwartz and Levine[5] found that it is unimportant in the production of early abortions and in the etiology of hemolytic icterus, sicklemia, hydatiform mole and ectopic pregnancies. The evidence is as yet inconclusive as to possible effects of the *Rh* factor in eclampsia and specific toxemia.

One line of investigation, however, has provided strong evidence that the incompatibility of mother and fetus may result in effects very different from those of classical erythroblastosis. Yannett and Lieberman, reporting at a recent meeting of the Association for Mental Deficiency, presented the results of the study of the *Rh* factor in feebleminded children and their mothers (cf. Cook[1]). Of the 109 feebleminded children, 53 were distributed among specific types of mental deficiency such as Mongolian idiocy and spastic diplegia. The distribution of the *Rh* factor was normal in these children and their mothers.

In the 56 children classified as undifferentiated mental deficiency, however, an abnormal distribution of the *Rh* factor was found. There were more *Rh* positive children from *Rh* negative mothers than would be expected in the basis of chance.

In the general population, 87 per cent of individuals are *Rh* positive and 13 per cent *Rh* negative.[6] Considering all the *Rh* positive alleles collectively, and letting p represent the frequency of *Rh*+ and q represent the frequency of *Rh*—, $p=.64$ and $q=.36$. Then homozygous *Rh*+ individuals (*Rh Rh*) make up 41 per cent of the general population, heterozygous individuals (*Rh rh*) occur in 46 per cent, and the *Rh*— individuals (*rh rh*) make up the remaining 13 per cent. Under a system of random mating, *Rh*— women will marry *Rh*+ men in 11.31 per cent of all marriages. But this 11.31 per cent will be made up of 5.33 per cent in which the husband is homozygous and 5.98 per cent in which the husband is heterozygous. The proportion of *Rh*+ children from *Rh*— mothers in the general population should therefore be $.0533 + \frac{1}{2}(.0598) = .0832$ or about 8 per cent.

We should not expect, however, that the entire 8 per cent of *Rh*+ children from *Rh*— mothers will show symptoms resulting from the incompatability. First-born children are seldom if ever affected[2] and thus the expected proportions of clinical cases will be reduced. In the American population the average number of children in families with at least one child is 3.24.[3] This would mean that one out of 3.24, or about 31 per cent of children born in this country are first-born. The expected proportion of children showing effects of the immunization of the mother by the *Rh* factor is thus reduced from .0832 to .0574 or about 6 per cent.

The incidence of erythroblastosis in full-term deliveries is 0.5 per cent[2] although in post-mortem studies of 2,000 deaths before birth or within one month of birth Potter[4] found that 2.1 per cent of the deaths in the white race were attributable to erythroblastosis. Considering the over-all incidence of erythroblastosis as 0.5 per cent, and the proportion of children not first-born who might be expected to show effects of the immun-

ization as 6 per cent, only one out of twelve pregnancies which could result in erythroblastosis actually does so.

This may be due, as has been suggested to the fact that some *Rh*— mothers are incapable of producing antibodies, or that the *Rh* antigen fails to get through the placenta in some instances. It is conceivable, however, that the immunization of the mother may in some instances result in effects other than those of classical erythroblastosis. It is important, then, to search for further manifestations of the incompatibility.

Yanett and Lieberman reported eleven *Rh*+ children from *Rh*— mothers among the 56 cases of undifferentiated mental deficiency, that is, 19 per cent. This is more than twice the expected 8 per cent of *Rh* + children from *Rh*— mothers. They found 14 *Rh*— mothers among the 56 mothers, which is 25 per cent, or about double the expected proportion of 13 per cent.

These results appeared to us so suggestive that we are at present testing the blood of the undifferentiated feebleminded at the Ohio Institution for the Feebleminded, and of their mothers. Due to transportation difficulties at the moment, mothers visit their children less often now than formerly, and the collection of data proceeds slowly. We have so far tested 66 mothers and their 68 feebleminded children, and our studies confirm those of Yanett and Lieberman. Of the 66 mothers, 17 are *Rh*—, nearly twice the expected frequency. Of the 68 feebleminded children, 11 were *Rh*+ from *Rh*— mothers. This is more than double the expected frequency.

Combining our results with those of Yannett and Lieberman gives clear statistical proof of the increased incidence of *Rh*— mothers among mothers of the feebleminded, and of *Rh*+ children from *Rh*— mothers among the feebleminded themselves (Tables I and II).

We are continuing these studies as rapidly as we can obtain the mothers of the patients at the Institution. It is important to collect data on the birth order of the affected children, and on the status of sibs in regard to erythroblastosis. Final proof of the effects of the immunization upon brain tissue must await the finding of erythroblastosis and feeblemindedness in the same families.

Should the evidence that an appreciable portion of feeblemindedness is caused by *Rh* immunization be accepted, an explanation would be at hand for some of the isolated cases of undifferentiated feeblemindedness in highly intelligent families, and also for some of the instances where two feeble-minded parents have produced normal offspring.

Table I. Comparison of observed (o) and calculated (c) numbers of Rh— mothers among the mothers of feebleminded children, combining the results of Yannett and Lieberman with those reported in this paper. $X^2 = 16.61$, $P < .01$

	o	c	o—c	$\frac{(o-c)^2}{c}$
Rh+ mothers	91	106.14	—15.14	2.16
Rh— mothers	31	15.86	+15.14	14.45
Total	122	122.00	0.00	16.61

Table II. Comparison of observed (o) and calculated (c) numbers of Rh+ children from Rh— mothers among the feebleminded, combining the results of Yannett and Lieberman with those reported in this paper. $X^2 = 14.42$, $P < .01$

	o	c	o—c	$\frac{(o-c)^2}{c}$
Rh— children and Rh+ children from Rh+ mothers	102	113.68	—11.68	1.20
Rh+ children from Rh— mothers	22	10.32	+11.68	13.22
	124	124.00	0.00	14.42

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THE BIOLOGY OF FASCIATION

And Its Relation to Abnormal Growth*

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The Blandy Experimental Farm, University of Virginia

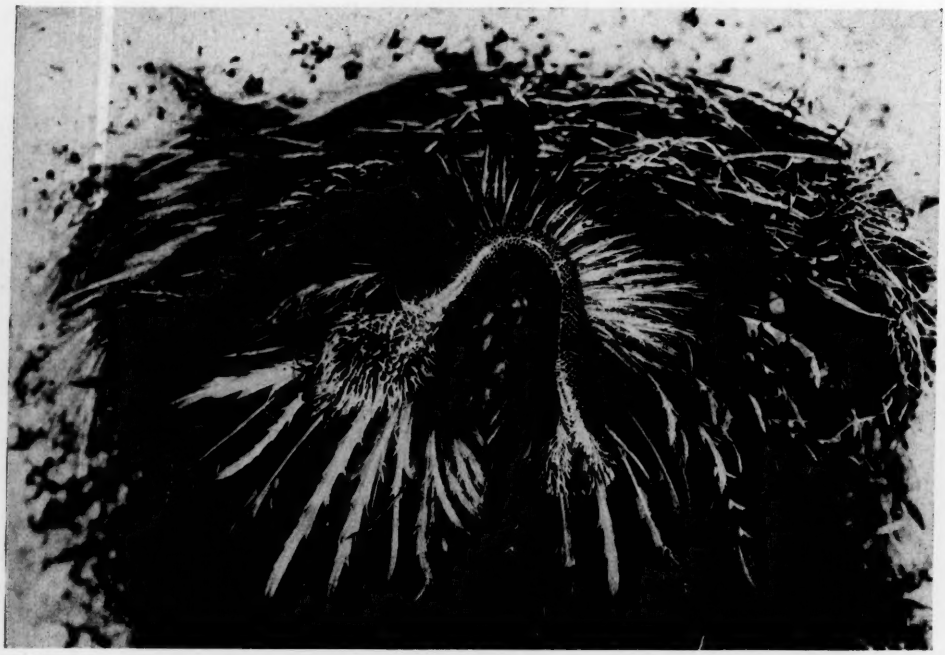
THE term fasciation, like the term cancer, has been used to describe a series of phenomena, the most striking feature of which is regions of uncontrolled or unregulated and disorganized tissue growth, resulting in an increase in weight and volume of plant tissue. Fasciation occurs commonly as an abnormal condition in vascular plants, although in at least one species, *Bauhinia* (the so-called tropical monkey ladders) and in one species of the parasitic mistletoe (*Phorodendron*), it appears to have become a normal phenomenon present in all the individuals of the species.

Morphologically, fasciation is generally manifested as a flattened or ribbon-like expansion of the main stem axis, although in such plants as *Lobelia syphilitica, Oxalis crenata,* and *Celosia cristata,* several stems may be thus transformed. When fasciation is a stem phenomenon, the early seedling growth stages of a plant thus afflicted are cylindrical and normal. As the plant approaches maturity, the growing point becomes broader and broader, often attaining a width of six to eight inches and sometimes several feet, as exemplified in the giant cactus of Arizona and the hoop pines of Australia. This growing point may be combed or diffusely branched in "witch broom" fashion, coiled like a snail shell helix or ram's horn, or distorted into a most intricate tangle of coils and partly broken stem tissue. Occasionally in certain plant types such as the garden pea, the main axis when fasciated becomes hollow and much distended forming a so-called ring fasciation type.

Although fasciation is most strikingly manifested in the growing point of the main axis, it may occur in practically any part of the plant, often resulting in altering the arrangement and increasing the number of foliar and flower parts. Roots, underground stems, leaves, number of cotyledons, as well as flowers, fruits, stems, and inflorescences have been recorded as fasciated.

When fasciation occurs in a specific structure, such as a branch, a stem, an inflorescence, an androecium, or a root, it may remain localized in these structures, or it may occur as a general phenomenon fundamentally and simultaneously affecting the whole plant. In such well known types as the common cockscomb, *Celosia cristata,* or the so-called Mummy or Crown pea, *Pisum sativum umbellatum,* with which Gregor Mendel worked, only the stems and inflorescences are affected. In the latter example, no fasciated pods have ever been observed, although the writer has grown thousands of fasciated pea plants representing scores of character combinations. In *Phyllocladus glauca* only the staminate cones show fasciation. In certain varieties of tropical yams only the tubers are fasciated, although recently, Wray Bowden has sent me a photograph of a striking stem fasciation in the ordinary cinnamon vine or Chinese yam, *Dioscorea batatas.* In *Oxalis crenata,* the "oca" of the Andean Indians, both tubers and stems are affected.[4] The Fairfax strawberry grown in the Southern States has many fasciated inflorescences, stems, and berries.[3] Practically all of the varieties of cultivated tomatoes commonly produce fasciated fruits, the only parts of the plant usually affected being the flowers, involving stamens, corolla, as well as the pistil. The only varietal type

Except for some minor modifications, presented September 13, 1939, at the Third International Cancer Congress, at Atlantic City, N. J.



FASCIATED THISTLE

Figure 6

Looking down on the U-shaped fasciated stem of this bull thistle (*Cirsium lanceolatum*) the growing "point" is represented by a considerable area. This is probably a non-inherited type of fasciation, but no observations were made on seedlings of this plant. After Aven Nelson.

of cultivated tomato from which fasciation seems to be absent is the Cherry. Occasionally stem fasciations of several types occur in the tomato and these may or may not be associated with fasciation in the fruits.

Next to the uncontrolled, unregulated, disorganized tissue growth, the most striking characteristic of fasciation is the great increase over the normal amount of tissue, calculated either by weight or by volume. Numerous illustrations from many species of plants could be cited, but that best known to me is the so-called Dewey Sport, which arose as a single plant mutation in ordinary Cuban tobacco.[11] This was a fasciated form, and individual progeny plants weighed over twice as much as their normal controls. They had more flowers with more flower parts (ranging from the normal five to as high as 25) and more leaves (ranging from 28 to 165 leaves per plant as compared with from 18 to 24 in the normal Cuban parent variety). Not only were flower parts increased in number, but different flowers on the same plant showed great differences in number of floral parts. Some flowers had 6 stamens, some 21, but most of them had 7, 8, or 9. Sepals, petals and ovary locules showed similar variability. There were numerous other abnormal modifications of the floral structures, which are reported in detail elsewhere.[11] Selection towards a more stable flower and leaf number was ineffective. In general, one may say that fasciation expresses itself in an expanding fashion as the plant matures. Where the flowers are affected, the greatest irregularities, disorganizations, and modifications appear in the

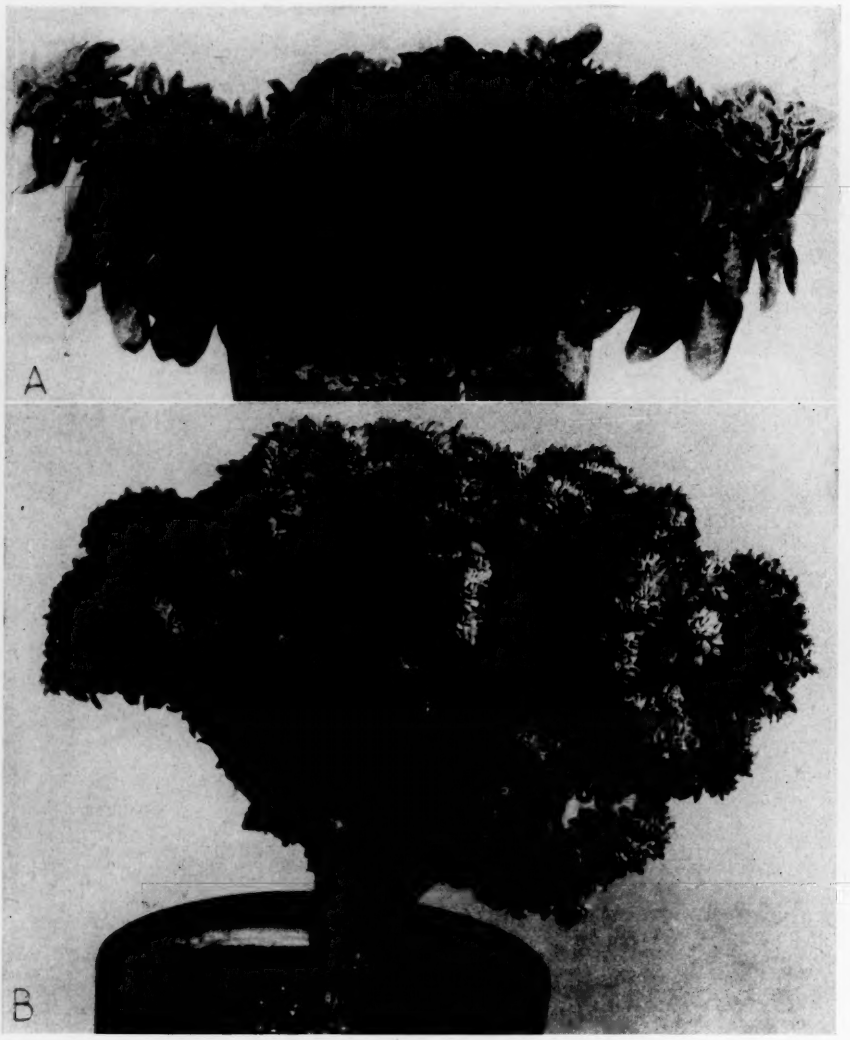
AUSTRALIAN PINE GONE WILD

Figure 7

Fasciation at top of an Australian hoop-pine, *Araucaria cunninghamii*, under cultivation in a park in Beecroft, Australia. The branches on each side represent the normal condition. The fasciated portion is over 26 feet high. Probably non-inherited type. After R. T. Baker and H. G. Smith in *Pines of Australia*, 1910.

gynoecium, yet although there is partial sterility, most fasciated plants produce plenty of seed.

Fasciated stems of the garden pea (*Pisum*) and tobacco (*Nicotiana*) show no difference in chromosome number or in chromosome form, according to my own investigations on *Nicotiana tabacum* and those of H. Heyn at The Blandy Experimental Farm on *Pisum* (unpub-



PETUNIA AND ECHEVERIA

Figure 8

A—Extreme fasciation in a plant of a diploid bedding variety of petunia. It never branched, but grew entirely as a single flat plate of stem tissue covered with leaves. Fasciations are rare in petunia, and this extreme deviation from normal growth is thus most remarkable. From Chas. M. Rick, W. Atlee Burpee Co. *B*—Fasciation in *Echeveria whitei*, which appeared spontaneously in 1932 in the Brooklyn Botanic Garden cultures of some asexually propagated normal material of this species brought from Central Bolivia by the author in 1921. This photograph appeared in *Cactus and Succulents Journal*, May 1937.

INHERITED FASCIATION IN TOBACCO

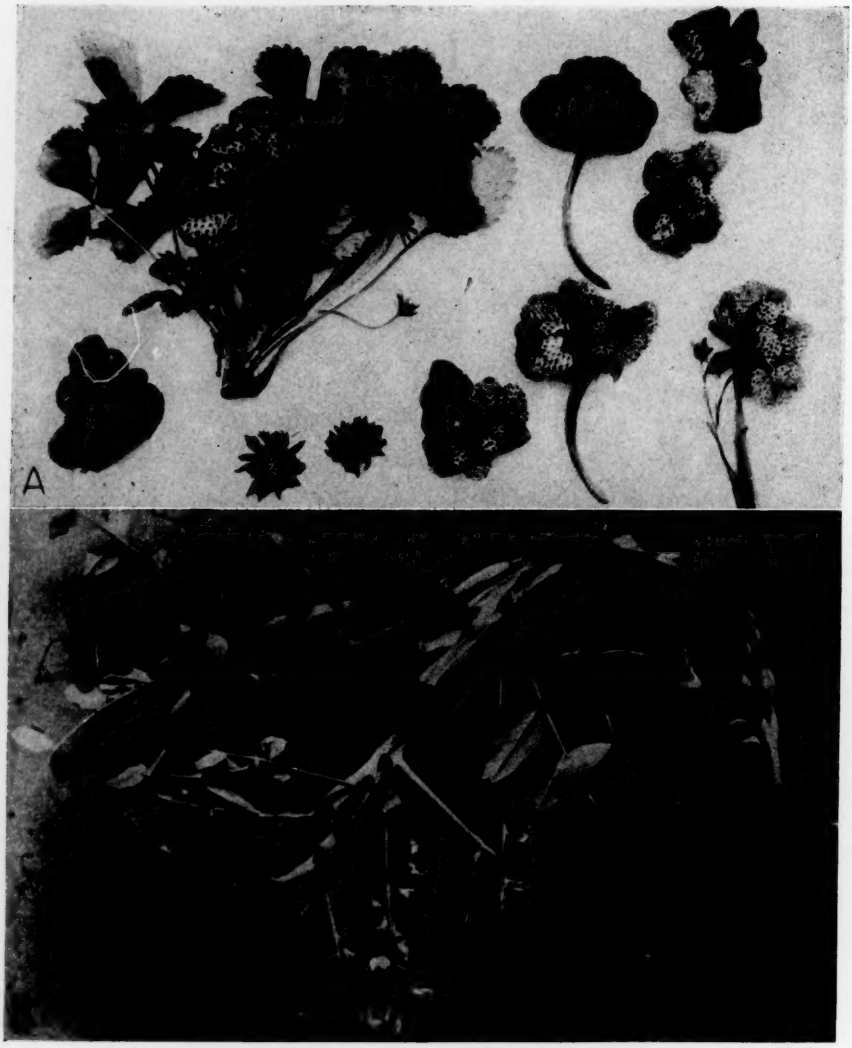
Figure 9

Two segregates showing the modifying effects of different genes in crosses between varieties of normal and fasciated tobaccos. Superficially the plant shown at *A* has but slight evidence of fasciation, yet it carries the gene for fasciation in homozygous condition and when crossed with appropriate normal forms, gives some progeny strikingly fasciated. Such a plant is shown at the right (*B*), a segregate from a cross between normal and fasciated races in which fasciation is very fully expressed. Note the irregular leaf arrangement, and the mass of distorted tissue and peculiar branching at the growing point.

lished). Meiotic irregularities of many types occur in fasciated strains of *Nicotiana tabacum*, occasionally resulting in anaphase differences showing an increase in chromosome number but this did not seem to be true of similar strains of *Pisum*. In no case were fasciated plants of tobacco or peas found with a change from the normal chromosome number.

Fasciation a Widespread Phenomenon

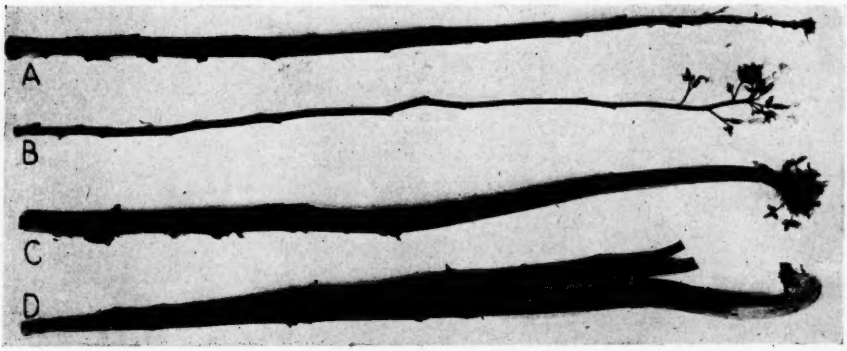
Fasciation is widely distributed geographically, climatically, ecologically, and taxonomically among vascular plant families. More or less typical examples of fasciation have been recorded from over 102 of Engler's vascular plant families, and the consensus of opinion seems to be that most vascular plant families



STRAWBERRIES AND PEAS FASCIATED

Figure 10

A—Fasciation in the Fairfax strawberry. From Geo. M. Darrow, U. S. Department of Agriculture. *B*—A genetically inherited true breeding form of fasciation in the garden pea. Enlarged to show the peculiar structural irregularities of the stem. In contrast to the strawberry, the pods are never fasciated in this form. This is one of the fourteen character-pairs Gregor Mendel studied in his pioneer genetic experiments.



NORMAL AND FASCIATED TOBACCO STALKS

Figure 11

Stalks from segregates of crosses between different varieties of fasciated and non-fasciated types. *A, C,* and *D* contain the gene for fasciation. *B* is homozygous for the normal allele. The leaf-count for the four stems is as follows: *A*—25 leaves, non-fasciated stem; *B*—25 leaves, non-fasciated stem; *C*—Over 70 leaves, angular-fasciated stem; *D*—Over 100 leaves, very flat fasciated stem.

have produced fasciations. In the Rosaceae, Leguminoseae, Onagraceae, Compositae, and Cactaceae, fasciation is *very* common. In water plants it appears to be very rare. The most familiar fasciation is that of the cockscomb, *Celosia cristata,* a plant originally from Asia where it has been cultivated for centuries and where the wild normal form, commonly known as *Celosia argentea* is common and widely distributed. Other plants commonly showing fasciation are the Tree of Heaven (*Ailanthus*), the Dorothy Perkins rose, *Oenothera biennis,*[9] *Delphinium,* the dandelion, and the snapdragon (*Antirrhinum majus*). One of Mendel's seven pairs of characters was a type of hereditary fasciation in peas which he called "umbellate," but which the French refer to as "Bouquet" peas. In England they are known as "Crown" or "Mummy" peas. Fasciation is equally well known among annuals, biennials, and perennials; among woody and herbaceous plants; and among shrubs, trees, and vines. In oriental countries, particularly in India, some fasciations have been venerated as divine symbols, multitudes coming to view them. Tadulingam and Cheriyan report[8] a fasciated pumpkin vine stem growing in a South Indian garden. It reached a total length of about 35 feet, the first 15 feet being normal, while the rest, 20 feet, gradually grew flatter and flatter until the axis terminated in a few irregular, hood-like lobes. "This monstrosity with a tale of its own attracted huge crowds of people who came with offerings, blindly believing it to be an incarnation of Nagasarpa (King Cobra)." In other words, owing to the kindness of the rich merchant in whose garden this fasciated pumpkin vine appeared, the gods incarnated what would have been a King Cobra snake into this monstrous pumpkin vine. Another example of a somewhat similar case, is that of a staminate palm inflorescence which was kept in a temple in India.

Previously mentioned was the species of tropical mistletoe or *Phorodendron* which apparently exists only in the fasciated condition. Around this plant have grown up a number of superstitions, one of which resulted in the name "Rose of Hell" being applied to it, together with the statement that it grew only on the lips of volcanoes. This species is not infrequently called the "wooden rose." While going through Laredo, Texas, in 1937 a Mrs. Shiner was kind enough to

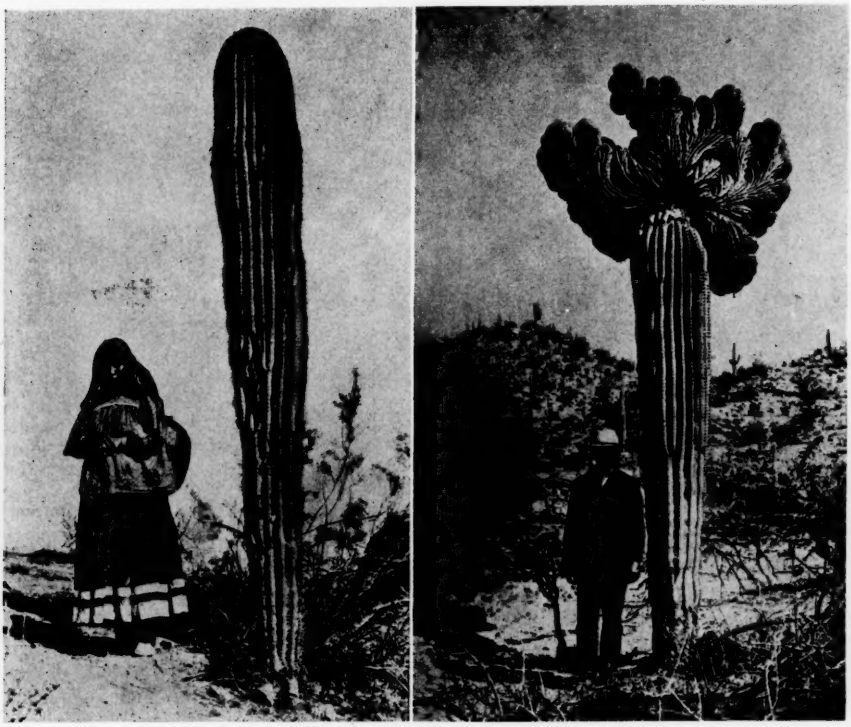
FLAT-STEMMED BUTTERCUPS

Figure 12

Note the broad stems among the mass of normal stems. Over half the plants in this group were fasciated.

show me a whole suite of furniture, including tables and chairs, made of the tree host and its gnarled parasite, the "wooden rose." This furniture, formerly the property of a Mexican general, was perhaps the most interesting as well as the most grotesque sight I have ever seen. The American Museum of Natural History has a reconstructed South American scene which gives a very impressive and adequate view of the so-called monkey ladders.

Some of the most striking fasciations known to me have occurred in the common bull thistle (*Cirsium lanceolatum*) (Figure 6). The giant cactus of Arizona (*Carnegia gigantea*) produces some notable specimens, which are called "cancer cacti." In a park in Beecroft, Australia, is an Australian Pine, *Araucaria cunninghamii*, having a fasciated top 26 feet high (Figure 7). Other striking forms are shown in the illustrations: a petunia (Figure 8*A*), and a fasciated form of *Echeveria Whiteii* (Figure 8*B*) that arose in greenhouse cultures at the Brooklyn Botanic Garden, also a pumpkin vine, grotesquely fasciated. Occasionally fasciations appear in large numbers of certain species of plants such as buttercups (*Ranunculus cymbalaria*) and wormseed (*Chenopodium ambrosioides* var. *anthelminticum*). Years ago in Maryland, many growers of canning peas found their fields 70 per cent fasciated and their crops mostly a loss.[1] Some



GROTESQUE CACTUS

Figure 13

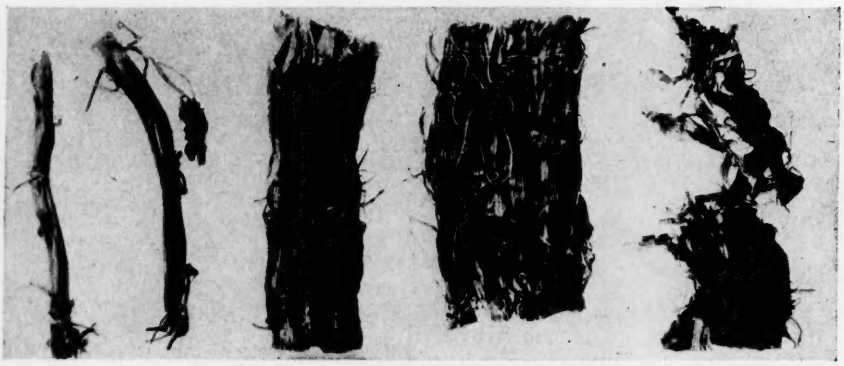
The normal columnar structure of the giant cactus (*Carnegia gigantea*) is compared with a so-called "cancer-cactus." Photographs from U. S. Department of Agriculture and the *National Geographic Magazine*.

of the most grotesque monsters of the plant world result from the presence of this character.

Causes of Fasciation

Numerous diverse internal and external factors operate singly or in combination to produce fasciation. If primarily internal, this character is hereditary, giving rise to races that breed true. Such I have grown in tobacco, corn, and peas, and Dr. George H. Shull has found one in *Oenothera*.[7] These hereditary races arise as mutations.

If the causal factors are external (insect depredations, mutilations, pressure and shock, weather conditions, etc.) fasciation is not inherited. Environmental fasciations have repeatedly been produced experimentally in a number of different plant genera.[5] In some cases these have been propagated asexually but never, so far as I am aware, by seed. Both externally and internally caused types of fasciation often occur in the same species, as has been recorded for the garden pea and for *Oenothera*. They may even occur in the same culture plot. These two types look alike in every respect, but from a genetic standpoint they are very different. In the case of the externally produced type, there is perhaps only one environmental stimulus which must be guarded against to prevent the development of fasciation. In the hereditary forms no alteration of the environ-



FASCIATION IN PUMPKIN VINE

Figure 14

Section to show the normal beginning and the disorganized end of the vine. The twenty-foot fasciated end grew progressively flatter until it terminated in a series of hooded lobes. This vine was visited by huge crowds of Hindus who believed it to be a vegetable reincarnation of a King Cobra. Drawings by Tadulingam and Cheriyan.

ment will eliminate fasciation. In over 20 years of experimental observation of the hereditary type of fasciation, under many different environmental conditions, I have seen it modified quantitatively, but I have never seen its expression completely inhibited by any environmental condition. On the other hand, I have grown under carefully controlled conditions seeds from a number of fasciated individuals of several species, including *Oenothera biennis,* and even where my progeny numbered hundreds, no fasciated individuals appeared in that or succeeding generations.

In breeding experiments the hereditary type may exhibit many variations in expression, depending upon the kind of genetic factors with which it is associated. In some cases, as discussed by Mendel in peas, and since confirmed many times by the writer and others, its inheritance is simple and monofactorial: the normal is dominant in the F_1 generation, and in F_2 segregation occurs in the ratio of 3 normal : 1 fasciated. In *Oenothera,* Shull[7] reports that monohybrid segregation was also obtained. In tobacco, the Dewey Sport, when crossed with the Cuban variety from which it mutated, gave an intermediate F_1 and an F_2 with a clear-cut 1:2:1 ratio. When crossed with normal varieties of tobacco other than the Cuban parent, the results were very confusing. Almost normal F_1's appeared, and the F_2 generation gave a graduated series from normal to fasciated. It is possible to pick out segregates that appear normal, and which produce progeny all phenotypically normal. Nevertheless, in appropriate crosses with normals of known genetic constitution, fasciated plants appear in the progeny. In such cases one can see how completely genetic factors or genes other than those primarily concerned with fasciation can modify the expression of the gene or genes for fasciation, and bring about very confusing results, as regards interpreting the inheritance of this character. A full discussion of such results as found in tobacco crosses occurs in an earlier paper.[11]

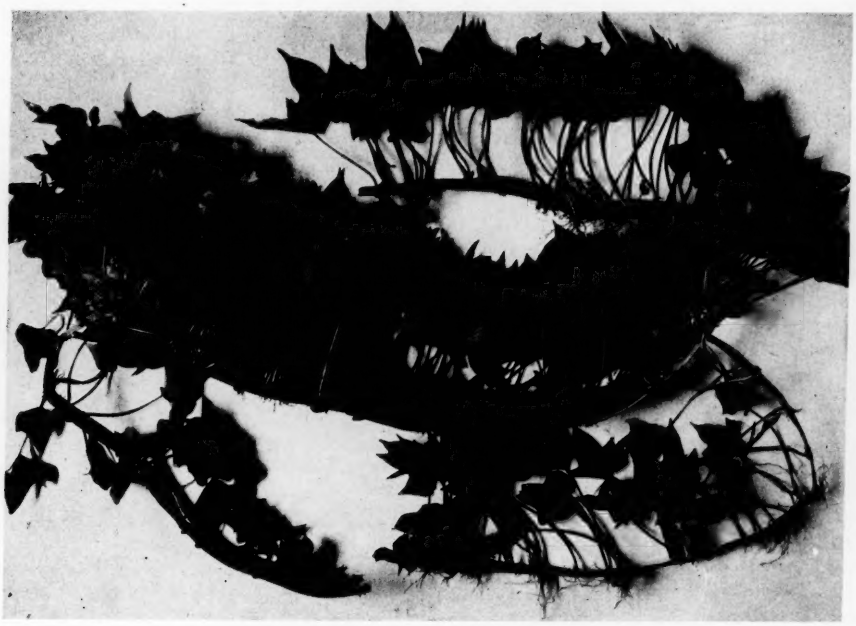
Fasciation and Cancer

Fasciation bears an analogy to cancer from the standpoint that apparently the same character is produced in a given organism by many different causes some of which are primarily and fundamentally environmental, while others are hereditary mutations. In some plant forms. the expression is relatively slight and can hardly be thought of as being harm-

FASCIATED SAXIFRAGE

Figure 15

Normal and fasciated plants of *Saxifraga irrigua*. Fasciation has been reported in about a third of the 290 families of vascular plants listed by Engler.



RIBBON-VINED SWEET POTATO

Figure 16

Fasciation in the common sweet potato showing the nearly normal stem near the base of the vine, becoming gradually broader toward the growing tip, which terminates (left) in a mass of leaves. Photograph by Robert E. Taylor.

ful to the organism that expresses it. On the other hand, there are races of plants in which this character occurs in such extreme expression that, though it does not kill the plant, it is definitely harmful, in causing broken tissues, distorted organization, decrease in fertility, and in all probability in adaptability. Environmentally produced types of fasciation may occur on woody plants as a fasciated limb or twig or as an overall phenomenon involving the whole plant. In succulent plants such as the euphorbias, the stonecrops, and the cacti, fasciations are referred to as cristates. This character occurs very frequently among these succulents and is often propagated asexually.[2] So far as I am aware, no one has attempted to raise them from seed. Hence we do not know whether such forms belong to the hereditary type. Apparently they can be propagated indefinitely, by asexual means, though occasionally normal shoots appear. Persons who have these cristates in flowering sizes would perform a real service if they would test any seed produced to determine how many of these cristates are environmentally caused and whether some of them represent hereditary mutations. If it were found that only normal plants are produced from seed, then an interesting problem arises to account for the transmission of this character from cell to cell in the asexually propagated plants.

Finally, fasciation in its nature, causes, and inheritance in vascular plants reminds one of the cancer problem in animals and human beings, since here too, there is artificial causation, gene or inherited causation, and perhaps gene modification in some cases. For an interesting discussion of this subject, the reader is referred to the discussion of this problem by Dr. D. F. Jones.[6]

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✦

The Newer Medical Genetics

By Associated Press:

BALTIMORE, Oct. 4.—A Baltimore physician, reporting a cure for supposedly incurable color blindness based on the theory that the affliction is mental and not physical, cited today as proof of his success nine young men now in the Army Air Forces.

Dr. Israel Dvorine, who described his method as a retraining of the eyes with color charts, said he was successful in 9 cases out of 12 and that the three who failed "just didn't want to try."

He has published two books containing more than 400 charts he developed and painted with water colors during the treatment of his young patients. One book is for testing, the other for treatment.

Different patients require different charts, he found, and his complete set covers the entire spectrum in pairs, and in varying tints and shades.

"The only medical idea of how we distinguish colors is that there are nerve ends in the eye which are able to tell them apart," he explained.

"But I have found there is more to it than this. * * * I believe color blindness, especially the inability to distinguish between colors side by side is mental, not a nerve trouble, and like any other mental deficiency it can be educated away."

"La nuit tous les chats sont gris."

DO BACTERIA HAVE GENES?

Comments on *Elements of Bacterial Cytology**

IN this summary of our knowledge of the structure of bacteria,* the problem of the existence and organization of nuclear material in these and related organisms is disposed of in relatively few pages. It is to these pages that the geneticist will find his interest drawn. Unfortunately Knaysi's conclusions are not entirely satisfying to one interested in how bacteria manage to keep their hereditary material in proper order. After presenting the evidence based on stained cells as micrographed with the electron microscope, he says, "The only conclusion to be drawn from this work which is supported by adequate chemical research and by the most powerful means of observation is that bacteria contain nuclear material, which depending on conditions yet unknown but probably related to environment and development, may be diffuse in the protoplasm or may be partly or totally differentiated into a nucleus. This conclusion supports the old hypothesis of a diffuse nucleus as formulated above and is not in contradiction with the hypothesis of a structureless nucleus."

In connection with the presentation of the cytological evidence as to the organization of nuclear material, it is most regrettable that the work of C. F. Robinow (*Proc. Royal Soc. London,* Series B 130:299-324, 1942) is not referred to. This oversight is undoubtedly to be attributed to war conditions, although it may be noted that Robinow's paper has been referred to at least twice in standard works published in this country (Lewis, I.M., *Chronica Botanica* 7:249-250, 1942, and Schultz, J., *Ann. Rev. Physiol.* 5:35-62, 1943). Robinow has demonstrated convincingly the existence of chromosome-like bodies in several commonly studied species of bacteria including both spore-formers and non-spore-formers. These bodies undergo regular division cycles not unlike those of chromosomes in higher organisms.

Knaysi does not attempt to approach the problem of nuclear material in bacteria from a theoretical genetic standpoint. On the contrary he appears to avoid this issue as evidenced by the following quotation: "It is not yet clear how the above experimental results can be interpreted genetically, but in dealing with bacteria and related organisms in which nuclear differentiation is not, apparently, a fixed characteristic, interpretations based on experience obtained with more highly organized cells cannot be accepted as binding laws; as in all scientific procedures, experience derived from the material under investigation should always procede and guide its own interpretation; perhaps here also, as is often the case in physiology, the behavior of highly organized cells may prove to be a special case of a more general biological process."

In the light of what we know about the relation of genes to metabolic processes in plants and animals in which sexual reproduction occurs, a geneticist might be disposed to argue that since these processes do not in any basic respect appear to differ in bacteria and other organisms and since in higher organisms they are under the control of genes, genes or their physiological equivalents probably exist in bacteria. Furthermore, if such units do exist in bacteria, it is necessary to assume an orderly mechanism of their reproduction and equal distribution to daughter cells. It is not required *a priori* that they be organized into chromosomes and nuclei as in higher forms, although the observations of Robinow (loc. cit) strongly suggest that even in this respect bacteria do not differ in a radical way from organ-

**Elements of Bacterial Cytology*, by GEORGES KNAYSI, 209 pp. Comstock Publishing Co., Inc., Ithaca, N. Y. 1944.*

isms with conventional nuclei. Subsequent to the publication of Knaysi's book the argument for the existence of gene-like units in bacteria has received substantial support in the work of Gray and Tatum (*Proc. Nat. Acad. Sci.*, in press) and of Lampen, Jones and Roepke (Paper presented Div. Biol. Chem., N. Y. Meeting Amer. Chem. Soc. Sept. 1944) who have shown that treatment of *Escherichia coli* and *Acetobacter malanogenum* with X-rays induces heritable modifications in synthetic ability of a type corresponding to those similarly induced in the fungus *Neurospora crassa* and known to result from mutations or losses of specific genes.

Other chapters of *Elements of Bacterial Cytology* deal with the forms of bacteria, the cell wall, properties of bacterial membranes, divisions, vacuoles and reserve materials, motion, spores, staining, and colonies. Chapters are included on the cytology of actinomycetes, spirochetes, and mixobacteria. Although it is a matter of minor importance, the reviewer is inclined to wonder why a discussion of theories and practices of staining is deferred to Chapter nine when they are so basic to a proper evaluation of the observational evidence on the organization of nuclear material, a topic dealt with in Chapter three.

Viewed broadly, Knaysi's contribution is a most valuable one. His treatment of the subject is modern. Advances made possible by the electron microscope are adequately presented. Principles of cellular physiology are applied where they are appropriate. Every bacteriologist with a grain of curiosity as to the physical structure of the organisms with which he works will want to have Knaysi's book available. In addition it should certainly be within easy reach of every other person who has occasion to know about the structure of bacteria.

Elements of Bacterial Cytology is well documented. Its bibliography contains some three hundred selected titles. There is is an adequate index. Physically the book is a credit to its publisher.

G. W. Beadle.

Stanford University.

The Expert and the American Way

Those who are interested in the development of eugenic programs will find no little meat in a statement by Dr. Robert S. Lynd, of *Middletown* fame:

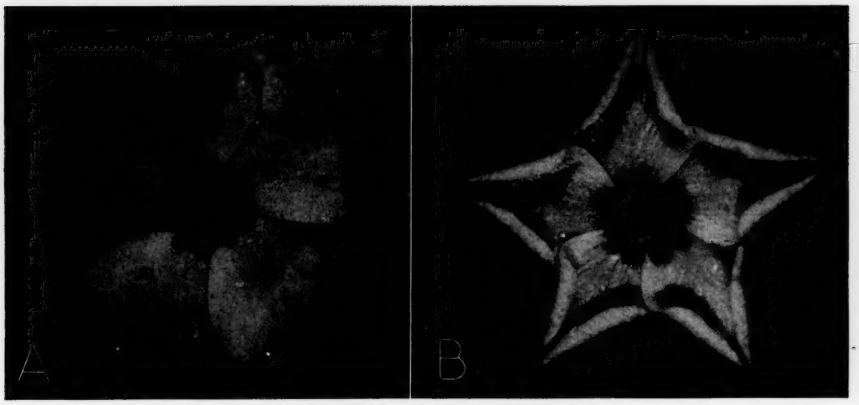
In a social situation as ravelled out as American life has become, the development of motivation and participation by democratic methods is the slow way and the hard way. Much easier is the way of force disguised under persuasive propaganda. In our present state—casually organized, only intermittently active as citizens, and primarily bent on personal security—we Americans are helpless ducks on a fence before the undemocratic sharp-shooting of such big-business power-blocs as the National Association of Manufacturers. What do, or can, sociologists know that will help to safeguard the use of this essential but double-edged instrument of group motivation?

From sociologists who work on problems of public opinion close work is needed on factors disposing Americans to oppose and to support central planning, and on how negative attitudes can be changed into positive attitudes. We need to know what the concept "national planning" means to different people, and why. We need to identify the strands of experience within our American institutional past which influence people in the stand they take regarding planning. Among these last one would probably find the following: (1) The American explanation of how progress has happened among us in the past tends to gloss over the large element of good fortune due to location and rich natural resources, the fact that all down through our national history we have had a lucky favoring tail wind, and to attribute our progress to the rightness of the "American way." We tend to believe that the situation of the United States is unique and fundamentally different from that of the older nations in Europe. And we tend to believe naively and uncritically that what has worked in our past will continue to work in the future. (2) We exhibit as a people a fundamental ambivalence towards change. We express instant hospitality to material changes in technology (bigger and better steel mills and assembly-lines and power dams) and toward science as represented by a man in a labora-

(*Continued on page* 28)

HOODEDNESS IN PHLOX*

JAMES P. KELLY
The Pennsylvania State College



ENLARGED VIEWS OF FLOWERS
Figure 17

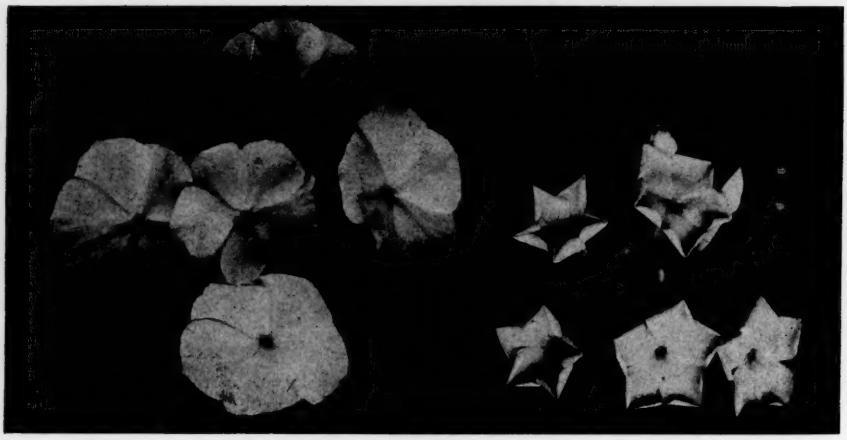
Enlarged views of the structure of a plane phlox flower (*A*), and a hooded flower (*B*), about three times natural size. The expression of the hooded gene varies from a marked curvature of the petals as shown here, to a slight uprolling of the edges. Some normal flowers transmit this tendency to their offspring even though they do not themselves show it.

THE original wild condition of the corolla lobes in the annual phlox (*Phlox drummondii*), would seem to have been plane or flat, especially at the flower edge. A few years ago, there arose in our cultures, a hooded or cuculate flower type in which the petal edges were uprolled lengthwise in such a way as to make a hooded edge. The hooded or cuculate condition is well shown in the photographs (Figures 17 and 18). For comparison in each of these figures, the original or plane-petalled type is shown to the left. The hoodedness in my progenies was not always so marked or extreme as that shown in these figures. There was often a lesser uprolling of the petal edge, giving a type designated as intermediately hooded (not figured). Since the hoodedness was found to be recessive or weakly expressed by heterozygotes, it is difficult to say when or in what cultures the cuculate mutation originally occurred.

Over several seasons, data were accumulated of 160 plants of the F_1 generation (see Table I). Most of these hybrids were classified as plane, but in some cases the F_1 plants were judged to possess flower edges slightly or intermediately hooded. No fully hooded flowers appeared.

Families of the F_2 generation were grown in 1936, 1938, 1939 and 1940 (see Table II). In the earliest of these years, 154 F_2 plants were grown; and of these only eight were judged to be extremely hooded. This ratio of 146:8, suggested that at least two pairs of genes must be involved in the expression of hoodedness, for it almost exactly fits the distribution of 144:10 expected were this a 15:1 ratio. The 1936 plants are the top ten families of Table II.

*Contribution from the Department of Botany No. 144. Publication authorized Dec. 1944 of Paper No. 1263 of the Journal Series of the Pennsylvania Agricultural Experiment Station.



PLANE PETALLED AND HOODED FLOWERS

Figure 18

On the left is shown the group of flowers at the top of a normal phlox plant, and to the right the hooded type, with uprolled petals. The difference between these two appears to be due to a single gene with much fluctuation in expression, believed to be mainly due to varying seasonal conditions. (Photographs by Dr. L. O. Overholts.)

When the F_2 individuals for 1938, 1939 and 1940 were recorded, however, it was found that there were 35 very hooded in a total of 201 plants which is a ratio of nearly 6:1. Naturally, one had to suspend judgment on the genes involved until fuller data on later families were available.

Tables III, IV and V give all the facts available on such groups (i.e., F_3-F_6 families).

Let us consider first, (in Table III) the descendants of selfed individuals classed as "intermediately hooded" appearing anywhere within this six generation pedigree. That is, Table III allows us to judge of the genotypes of intermediates from the composition of the families they originate. Fifty-nine such families appear in Table III. Arranging the families with most variability above, we find 35 that point to intermediate hooding being conditioned by a difference in a single gene without dominance. Summarizing that part of the table we have as the descendants derived from selfing 35 intermediate hooded plants a distribution of 110 plane : 216 intermediate hooded : 132 hooded. This is a close approximation of the 1:2:1 expected where a single allelic difference distinguishes hooded from plane, with the heterozygous intermediate.

In the second part of Table III are 24 progenies of selfed intermediates which do not give 1:2:1 ratios. Fifteen of these (36-51 inclusive) gave rise to plane-petalled plants almost exclusively, i.e., to the same kind of families expected of uncrossed or true-breeding "planes." This can be interpreted to mean that genotypically homozygous planes occasionally develop slightly up-rolled petals which cannot be distinguished from intermediately hooded.

A reverse situation seems to be found in the progeny of plants 52, 53, 54, and 55 of Table III. These progenies are almost exclusively hooded, of the type to be expected from homozygous hooded plants. These four parents, phenotypically intermediate plants, must actually have been genotypically homozygous. Finally the last four intermediately hooded parents showed their intermediacy to be pure breeding. In those cases, we surmise that these plants are

homozygous hooded, and that a modifying factor also homozygous, has inhibited the full expression of the hooding gene.

Table III then points to a single pair of genes being involved, with much fluctuation in expression of the characters. It gives some evidence also that the fluctuations are at least in part genetically conditioned.

In Table IV will be found all of the cases involving segregate plane-petalled plants, selfed and used as parents, together with their immediate descendants. A large majority of these (30 out of 39 involved in the table) did just what would be expected if pure-bred planes were inbred, i.e., they gave nearly all plane descendants along with a few classed intermediate. A few segregates ranked "plane" (i.e., those numbered 31 to 39) proved to have been heterozygous as judged by their families, suggesting the 1:2:1 type again.

In Table V are gathered together all the data relating to the immediate progeny of segregates classed as hooded phenotypically. The majority of such hooded parents behaved as pure breeding homozygous hooded might be expected to do. Their descendants are hooded, varying from extremely to shallowly hooded. The shallow-hooded might be classed as intermediately hooded. Parents 5 and 12 in Table V were phenotypically "very hooded" but their offspring in other years showed a lessened expression of the hoodedness.

In conclusion, then, so far as genes

TABLE I

Plane X Hooded Crossing No.	F₂ Descendants Plane	Int.	Hooded	Totals
1	7	-	-	7
2	5	-	-	5
3	1	-	-	1
4	3	-	-	3
5	-	2	-	2
6	-	3	-	3
7	-	7	-	7
8	-	8	-	8
9	-	6	-	6
10	18	-	-	18
11	7	-	-	7
12	2	-	-	2
13	18	-	-	18
14	-	14	-	14
15	6	-	-	6
16	3	-	-	3
17	7	-	-	7
18	7	-	-	7
19	8	-	-	8
20	8	-	-	8
21	20	-	-	20
Total				160

TABLE II

F₁ Parentage No.	Type	F₂ Descendants or families Plane	Int.	Hooded	Total
1	Int.	39	3	-	42
2	"	26	3	-	29
3	"	8	3	-	11
4	"	5	2	1	8
5	"	3	2	-	5
6	"	1	1	-	2
7	"	-	5	-	5
8	"	8	1	1	10
9	Plane	3	1	1	5
10	"	17	15	5	37
11	"	8	1	4	13
12	"	6	5	3	14
13	"	22	-	7	29
14	"	23	-	8	31
15	"	10	-	3	13
16	Int.	5	5	1	11
17	"	3	4	1	8
18	"	3	6	1	10
19	"	15	6	1	22
20	"	6	11	5	22
21	"	3	6	1	10
22	"	18	-	-	18

TABLE III

Parents of Interned. Type	Descendants (F_2-F_6) Plane	Int.	Hooded	Totals
No. 1	4	1	9	14
2	2	2	9	13
3	6	9	5	20
4	2	-	4	6
5	5	5	9	19
6	6	9	3	17
7	4	13	7	24
8	4	9	6	19
9	8	13	6	27
10	2	6	2	10
11	2	8	2	12
12	1	1	-	2
13	6	12	3	21
14	6	6	2	14
15	4	9	2	15
16	5	9	4	18
17	2	7	3	12
18	3	12	6	21
19	-	6	-	6
20	-	2	1	3
21	2	5	1	8
22	2	4	2	8
23	1	5	1	7
24	-	4	-	4
25	4	2	-	6
26	-	5	2	14
27	3	5	3	11
28	1	1	1	3
29	4	11	5	20
30	6	12	4	22
31	3	7	3	13
32	1	1	1	3
33	3	4	13	20
34	4	9	11	24
35	2	2	2	6
Totals 35 families	110	216	132	458
No. 36	6	-	-	6
37	11	-	-	11
38	11	-	-	11
39	19	-	-	19
40	13	-	-	13
41	8	-	-	8
42	14	-	-	14
43	14	-	-	14
44	10	1	-	11
45	10	-	-	10
46	5	-	-	5
47	26	1	1	28
48	10	-	-	10
49	9	-	-	9
50	9	-	-	9
51	8	-	-	8
52	-	2	12	14
53	-	-	21	21
54	-	1	20	21
55	-	-	30	30
56	-	26	-	26
57	-	4	-	4
58	-	10	-	10
59	-	8	-	8

TABLE IV

Parents of Plane type	Descendants (F_2-F_6) Plane	Int.	Hooded	Total
No. 1	13	-	-	13
2	17	-	-	17
3	13	1	-	14
4	7	-	-	7
5	7	3	-	10
6	31	-	-	31
7	24	-	-	24
8	18	-	-	18
9	17	-	-	17
10	19	-	-	19
11	13	-	-	13
12	13	-	-	13
13	9	1	-	10
14	9	-	-	9
15	11	-	-	11
16	3	-	-	3
17	18	-	-	18
18	24	1	-	25
19	34	-	-	34
20	5	-	-	5
21	4	-	-	4
22	17	-	-	17
23	33	-	-	33
24	6	-	-	6
25	8	-	-	8
26	25	-	-	25
27	7	-	-	7
28	9	-	-	9
29	3	-	-	3
30	12	1	1	14
31	11	20	5	36
32	12	8	6	26
33	2	3	2	7
34	4	5	9	18
35	3	4	5	12
36	5	4	2	11
37	5	8	4	17
38	3	2	1	6
39	2	-	1	3

TABLE V

Parents of Hooded type	Descendants (F_2-F_6) Plane	Inter.	Hooded	Totals
No. 1	-	-	10	10
2	-	-	6	6
3	-	6	11	17
4	-	3	25	28
5	-	23	-	23
6	-	-	34	34
7	-	5	-	5
8	-	7	17	24
9	-	-	15	15
10	-	-	11	11
11	1	14	20	20
12	-	14	-	14
13	-	-	4	4
14	-	-	3	3
15	-	-	12	12
16	-	-	9	9
17	-	-	8	8
18	-	-	19	19
19	-	-	14	14
20	-	-	16	16
21	-	-	10	10
22	-	-	6	6
23	-	-	9	9
24	-	-	10	10
25	-	-	11	11
26	-	-	1	1
27	-	-	2	2
28	2	-	5	7
29	5	10	4	19
30	7	17	7	31
31	11	6	2	19
32	-	1	1	2
33	11	10	2	23
34	7	2	-	9
35	1	5	2	8
36	1	3	4	8
37	3	3	1	7
38	3	3	2	8
39	3	3	2	8
40	2	3	3	8
41	2	-	-	2
	57	65	35	157

are concerned, we would seem to have a single allelic pair, *C-c*, distinguishing plane petals from hooded or cuculate petals in *Phlox drummondii*. The allele *c* when homozygous (*c-c*) conditions hooded or cucullate, while genes *C-C* condition a plane petalled phenotype. Often *C-c* plants are intermediately hooded but with a variable expression. No attempt has been made to correlate the varying expression here reported with specific seasonal or environmental influences suspected of causing the fluctuations.

◆

THE EXPERT AND THE AMERICAN WAY

(*Continued from page* 24)

tory looking down the barrel of a microscope. But we tend to tighten up and become reluctant to change in our basic non-material cultural traits—our form of government, our laws of property, the rules by which our economy operates. (3) Following from the preceding, we are ambivalent about superior persons, especially "experts." The cracker-box tradition that scoffs at experts has changed as regards engineers, medical men, and men in white coats in laboratories working with test tubes, but it still begrudges recognition to experts in other institutional matters. Married men, for instance, are apt to feel that nobody can tell them anything about being husbands and fathers. (4) The deep American tradition that "that government is best that governs least" stands squarely in the path of a shift to planning headed up in Washington. We are used to the idea of business using the government to do things for it like creating protective tariffs, but we bristle when government "interferes" in other areas of living. (5) Likewise, Americans tend to think that "bureaucracy" is a disease peculiar to government. We fail to recognize that bureaucracy is normal to big administration of any sort, including large business corporations. (6) The defensiveness and negativism of an insecure middle class stand in sharp contrast to the positive mood required for orientation to planning. (7) The association of national planning in American experience with unfortunate emergencies (two wars and a disastrous depression) has encouraged an attitude towards planning as a merely temporary device, useful to get things back to "normal" but to be discarded immediately thereafter. (8) As a nation we boast of freedom at the same time that we have allowed freedom to become largely negative, defensive, freedom *from* invasions of our persons and property. The positive statement of freedom lives on principally in the clamor for freedom of enterprise. In other words, American democracy has so far lost sight of what democracy can become that the principal goal it states for itself is that the individual be left to struggle alone to make money. But the major tendency of our time is towards *collective* effort; for massed urban living, depressions and wars are teaching us that social fate is increasingly a collective affair. Freedom envisaged as a lone personal achievement tends increasingly to get lost under the feet of organized institutional coercions. One of the most grotesque and disastrous lags in American democracy is the current widespread exploitation of people in the name of freedom. But, as Walton Hamilton has remarked, private business succeeds better than government in imposing its coercions because they are disguised as choices. So we are unprepared to view national planning as providing that enhanced clarity and coherence of structure so essential within the culture and within the person if we are to achieve the freedom democracy promises.

I may mis-appraise the relevance of some of the above eight factors as formative of American attitudes towards planning. The purpose in citing them is to suggest the type of cross-analysis of cultural factors and attitudes that is needed.—Robert S. Lynd, *Amer. Soc. Rev.*, Feb., 1944.

AN ACEPHALIC LAMB MONSTER IN SHEEP

And Its Relation to Single-Egg Twinning in Sheep*

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THIS paper reports observations made on an abnormal lamb fetus which was brought to the department of genetics of the University of Wisconsin, March 7, 1928. It was said to be a twin to a normal ewe lamb born at full term. The breed was given as Hampshire but no pedigree was available. On arrival the fetus was photographed and placed in embalming fluid. The observations reported here were made in 1930 while the junior author was a student in the department. The case is of interest in its relation to the question of twinning in sheep.

At first glance the specimen looked like a rounded mass of wool, but rudimentary hind legs gave it the semblance of the hind quarters of a lamb. The anterior end was smoothly rounded over. The size was comparable to the corresponding parts of a normal lamb and the wool was normal and well developed. At the posterior end was a tuft of wool superficially resembling a tail (Figure 19, *t*) but it was composed only of fleece. Ventrally, in addition to the umbilical cord (Figure 19*A*, *umb. cd.*), was a flap of skin (*fl.*) covered with fleece on its ventral surface, which had somewhat the appearance of a scrotum and may possibly have represented that structure; but detailed examination did not yield convincing evidence. Except for the woolly covering, this lamb acephalus resembled very closely acephalic human monsters that have been pictured (see, for example, Guérin,[3] Pl. XXIII).

The specimen lacked not only a head and thorax but also the organs normally contained within these structures. Dissection revealed an abundance of adipose tissue beneath the skin, interspersed with strips of connective tissue and underlaid with a dense layer somewhat like deep fascia. This muscular tissue had not attained full development, and the different muscles could not be identified, the entire muscle mass being fused into a soft spongy substance. The tendons could not be followed into the muscles to any definite extent because of apparent disintegration. It is possible that death of the fetus may have occurred some time before birth and that degenerative changes in the tissues had already begun. Postnatal change could not have been great, however, as there was no indication of putrefaction when the specimen was received. It would be difficult to determine to what extent the conditions found were due respectively to initial lack of differentiation and to later disintegration.

Transverse sections of the muscle did not reveal separation into bundles, but showed evidence of incomplete cellular development or degeneration throughout. An attempt was made to tease the fibers out under low power magnification but this was only partly successful, the fibers being too fragile. Muscle on the right leg had developed to a greater degree than that of any other region.

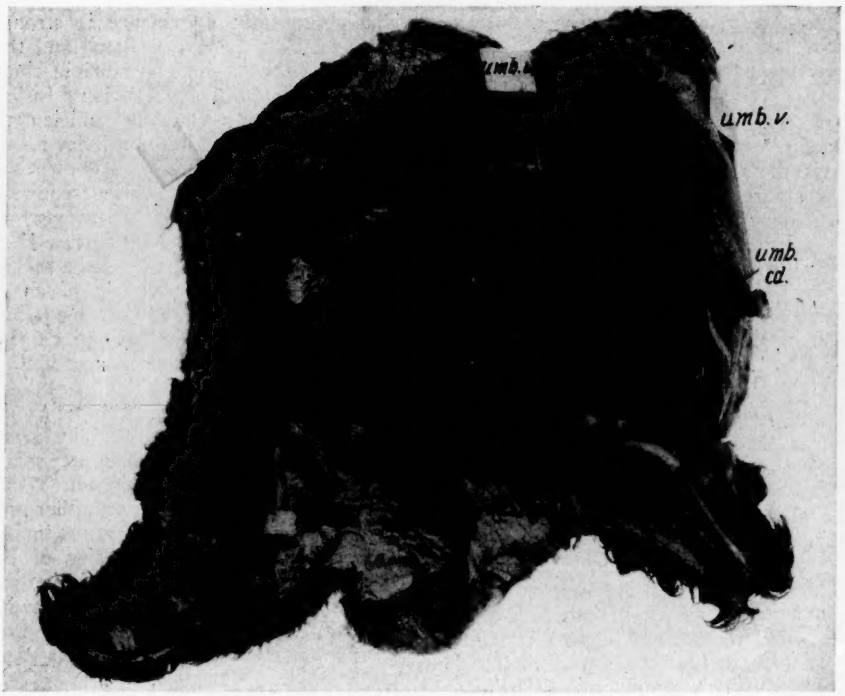
The skeleton also was decidedly meagre. A piece of cartilaginous tissue, which may have represented an abortive spinal column, was found in the muscle mass dorsal to the body cavity about two centimeters anterior to the pelvis, but no other structure was found which resembled a vertebra. Bones of the right leg

*Paper No. 335 from the Department of Genetics, Wisconsin Agricultural Experiment Station.

THE HEADLESS LAMB

Figure 19

Ventral view (*A*) and dorsal view (*B*) of acephalic lamb. The hind legs are extended and the fore part of the body is entirely missing. The ventral view shows the umbilical cord (*umb. cd.*), the tuft of wool in the tail position (*t*), and the flap of skin (*fl*) covered with wool on the ventral side. This lamb, born twin to a normal lamb, is an evidence of a partial twinning process. It indicates that identical twins do occur in sheep, a point on which conclusive evidence is still lacking.



INTERNAL STRUCTURE

Figure 20

Ventral dissection with most of the semi-amorphous muscle mass removed. Only a few bones and internal organs are present even in token form. *Int.* intestine: *fem. r.*, right femur; *pel.*, pelvis; *tib. l.*, left tibia; *tib. r.*, right tibia; *umb. cd.*, umbilical cord; *umb. v.*, umbilical veins.

were more highly developed than the other bony tissue. These were covered with periosteum and were hard. The proximal end of the femur, however, was broken and appeared to be incompletely ossified. The left femur, tibia and fibula were marked only by a lump of bone somewhat irregular in shape and attached to the pelvis and the tarsus joint by a single string of tendonous substance. The phalanges were completely lacking for the left leg, while these were fused in the right. The pelvis was brittle and lacked periosteum. There was no evidence of sacral or coccygeal bones.

The intestines occupied a small cavity anterior of the pelvis, which was the only body cavity present. Coils of the intestine resembled the small and large bowel but were so brittle after preservation that differences in detail could not be determined accurately. The small intestine was attached blindly to the anterior dorsal side of the body cavity. No structure resembling a stomach was detected; nor was there any evidence of a liver, pancreas or any other gland. Sex was undeterminable, as there was no indication of a urogenital system.

The umbilicus was near the anterior end of the specimen and served to indicate the ventral side. The umbilical cord leading from it can be seen in Figure 19*A* (*umb. cd.*), and in the dissection in Figure 20 threads have been attached to designate the severed umbilical blood vessels (*umb. v.*), which were relatively well developed. Injection of the vessels

was not feasible and they were so brittle that no attempt could be made to trace their course in the body.

Nerve fibers came off from incompletely formed or disintegrating tissue about two centimeters anterior to the pelvis, the region of the single cartilaginous structure which may have been a rudimentary vertebra. These branched into the legs but because of the fragile condition it was extremely difficult to trace them. A piece of the disintegrating tissue was thought to be a nerve ganglion but microscopic observation, after treatment with silver salts, did not yield convincing evidence.

A significant feature of this specimen was the complete absence of a heart (holoacardius). As Arey[1] (p. 170) says: "Besides twin individuals of normal structure and size, instances occur in which one member is smaller and incapable of independent existence. The heart of such specimens is either rudimentary or absent, and there is a corresponding degree of dependence on the normal twin for some or all of the blood supply. This supply may be direct, as the result of fusion between their two bodies, or indirect through the collateral circulation of a common placenta." Kaufman[6] (p. 67) states that this anomaly is rare and occurs only in unequal monovular twins, with a common chorion (*gemini monochorii inequalis*). It was stated definitely that this sheep acardius was a twin but the fetal membranes were not available for study. Sex of the normal twin was reported as being female. The circumstantial evidence is strong, however, that the normal lamb and the acardius were of single-egg origin since it is very doubtful that chorionic fusion of biovular twins would be sufficient to maintain circulation in the inferior member of the pair.

Very little is known of the frequency of identical (uniovular, monozygotic) twins in sheep but so long ago as 1898 Assheton[2] described and figured a seven-day old blastodermic vesicle of sheep with two developing embryos. He pointed out that this might have given rise to twins or to a double monster if they later fused. Further evidence, at least circumstantial, for identical twins in sheep was recently presented by Henning,[4] who described a double pregnancy with only a single corpus luteum. While the case here described adds another presumptive instance of single-egg twinning it does not alter the conclusion of Joansson,[5] based on analysis of the sex ratios of twins, that "monozygotic twinning is at most a comparatively rare phenomenon in the sheep."

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✦

Preventing Socio-Sterilization

In the judgment of the writer this factor alone [economic and social advantages of relative childlessness] should lead us to consider how we might redistribute our population into environments where the replacement of numbers can be reconciled with the value of daily living, where raising children does not appear so arduous a task that a considerable proportion, about one-fifth, of all couples where the woman is married under 45 will not undertake it at all, and another one-fifth will have only one child when it takes an average of 2.5 to each married couple to keep up our numbers. I will repeat again that any civilization which thus sterilizes or nearly sterilizes a large part of its population cannot possibly long endure. Its values are personal rather than racial and social. . . . . and leave out of account the needs of the race and the establishment of continuity in family and community living. —Warren S. Thompson, *Plenty of People,* page 130.

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